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ABSTRACT

The implications of Soviet psychoeducational research on learning disabilities (LD) and its relevance to American research and practice are discussed. The first section provides an overview of the general perspective of Soviet special education, with particular reference to LD and its relationship to Soviet psychology and philosophy. The second section presents a review of published experimental psychological research with LD children in the following areas: visual/auditory perception, attention, memory, and cognitive function. The final section draws implications for American work including the recommendation that American research ought to focus on constructing an adequate general theory of the integrated system of psychological processes underlying knowledge acquisition. (Author/PHR)

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Soviet Psycho-educational Research on Learning Disabilities: Implications for American Research and Practice

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Soviet psycho-educational research with children "temporarily retarded in psychological development"[1] (LD) has a relatively short history, dating, for all practical purposes, only from a 1969 conference convened by the National Institute of Defectology. The proceedings of this conference (Vlasova & Pevzner, 1971) consisted primarily of reports of research of a clinical and pedagogical nature, focusing on syndrome definition, classification, and differential diagnosis. In the ten years since this conference, however, experimental investigation of the psychological characteristics of LD children has become an increasingly important facet of Soviet defectological work. This research has concentrated on individual differences in processes of attention, visual perception, memory, and auditory and visual comprehension with a view to identifying possible loci for learning disabilities associated with school failure. These studies also illustrate a particular psycho-philosophical perspective and an orientation toward both educational programming and empirical research at variance in certain central respects with that underlying American literature on the learning disabled child.

In order to summarize this experimental research effectively and to discuss its relevance to American research and practice, this review will be divided into three major sections. The first section will provide a brief overview of the general perspective of Soviet special education with particular reference to learning disabilities and its relationship to Soviet psychology and philosophy. The second section will present an illustrative review

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of the published experimental psychological research with LD children. The final section will be devoted to an explicit articulation and summary of implications for American work which can be drawn from both the general Soviet theoretical orientation and specific Soviet research on learning disabilities.

Soviet Psycho-philosophical Perspective and Psycho-educational Research

In the USSR, philosophical considerations explicitly influence psychological theory (Payne, 1968) and psychological theory helps determine educational practice. This interdependence among philosophical, psychological, and educational principles has produced a Soviet psycho-educational research tradition marked by several special characteristics: 1) emphasis on the role of practical activity in an objective physical-social world in the development of knowledge; 2) concern with the nature of conscious knowledge as a guide to human action; 3) a dialectical, genetic perspective which focuses on intelligent human action in its development, a development that proceeds by stages and as an active process; and 4) a socio-cultural perspective from which the development of the child's intelligent activity is seen as reflecting adult-child social interactions, especially those which involve the linguistic systematization of cultural knowledge.

Knowledge, consciousness, and practical activity. Soviet philosophy (Lenin, 1927) is based on twin assumptions that a real material world exists in independence of knowing subjects and that human knowledge (the individual's and society's) becomes progressively more adequate to the world over time. The source and the criterion of the adequacy of knowledge is practical action.

Human action in the world develops and corrects human knowledge. For psychology, this suggests that the characteristics of human thinking may be understood through an analysis of intelligent action. In fact, Leont'ev (1972) makes the strong claim that the structure of human action becomes the structure of human thought. For special education, this view of the epistemological role of action implies a reliance in the diagnosis of developmental disabilities on an analysis of patterns of activity (i.e., a process rather than a product analysis) and an emphasis in the design of remediation on the active manipulation of concrete materials in meaningful, ecologically valid situations.

In addition to asserting that practical activity in the environment feeds back to correct and develop human knowledge, Soviet theorists also assert that conscious knowledge serves to direct that very activity, providing human beings with the means by which they can alter their environment and become capable of self-development (Simon, 1957; Gal'perin, 1957). For Soviet psychology, this view suggests that behavior cannot be studied apart from a description of the knowledge which guides and directs that behavior. Understanding of human action requires study of that action as intelligent and knowledge-guided. For special education, this implies that interventive efforts should not be designed to deal solely with surface behavior (i.e., performance) while ignoring the child's knowledge (i.e., competence) and understanding of what is expected of him in a situation (i.e., ability to recognize competence-appropriate performance situations). For behavior to be adequate and intelligent, the child must comprehend what he does and why he does it.

Dialectical developmental viewpoint. Soviet philosophy asserts that everything which exists, exists in constant alteration and development which is both continuous and discrete (i.e., stage-bound). Gradual quantitative change gives rise to sudden qualitative changes in which phenomena become determined by new sets of laws to which they were not previously subject. This development occurs as the resolution of contradictory tendencies internal to phenomena. Thus development is self-development, the motive force for which lies within the phenomenon rather than with its surroundings. Lastly, development not only occurs by stages, but new stages integrate previous stages so that characteristics existing at a lower stage reappear at higher stages in continuous progression.

The implications of this philosophical position for psychology are several. First, psychology must be a developmental psychology. Psychological phenomena can only be properly understood in the process of development. Second, psychological theory must, where appropriate, be stage theory. Since development is qualitative as well as quantitative, psychological phenomena are best understood in terms of relatively constant, integral unities at particular points of a genetic process, or stages. Lastly, since the psychological organism is an active unit which contains the motive force of its own development, psychology can not be based on models which conceive of the human knower as a passive receiver of sensations but must instead be based on a conception of man as an active cognizer.

A number of concepts in Soviet defectology can be traced to these views. The severity and the source of developmental deficits, for example, are

typically evaluated in terms of qualitative process variations in performance on complex tasks rather than on the basis of quantitative products such as the number correct on a psychometric instrument (Luria, 1961). In the design of remedial instructional techniques, the principle of self-development implies that the essential task of educational work must be to provide children with the means (i.e., internalized organizational principles consciously understood) to continue developing themselves.

Socio-cultural determination. Society, language, and culture have, in the Soviet view, evolved from group labor as tools through which man alters the world and develops human consciousness. From this point of view, Vygotsky (Leont'ev & Luria, 1968) developed a socio-cultural theory of cognitive development which has heavily influenced special educational practice in the USSR. This theory centers on the concept of "cultural mediators"--socially developed instruments (of which language is the most important) by which the child develops the capacity to regulate his/her own higher mental functions. The two primary characteristics of cultural mediators is that they are socially transmitted and that they are "signs" which reflect one or another aspect of reality. Using such signs, the individual becomes capable of detaching practical activity from its specific social-physical context, abstracting, generalizing, and internalizing the structure of the activity as the organizational basis for higher mental functions such as complex perception, voluntary memory, and logical thought. Human psychological development, in other words, involves a progressive, socially-mediated, transfer of control from the environment to the individual.

In the analysis of the development of this self-regulatory capacity, Vygotsky (1962) suggested a central role for cooperative social intercourse. The child's cognitive development begins in the earliest interactions with parents and siblings and extends through cooperative relations with teachers and other adults in society. At every stage of development, children find themselves confronted with situations which require skills which they do not yet possess. In such circumstances, adults and older siblings may intervene to provide information and strategies preprequisite to adaptive action. Based on this fact, Vygotsky argued that performance which is initially dependent on social assistance comes eventually to be independent as the child incorporates into the structure of its own action and eventually internalizes the organizational principles inherent in the assistance which is received from others.

One of the primary implications of this principle of the social origin of cognitive development for Soviet psycho-educational practice relates to the problem of assessment. As Luria (1961) points out, "When we know that the higher psychological processes, including intellectual activity, have this complex developmental history and are formed in the course of the child's speech-based social relationships, can we continue to adhere to the former static principles in assessing a child's abilities and intellect? Can we continue to make confident judgments of a child's intellectual development merely on whether he performs a given task on his own with greater or lesser success (p. 40-41)" In answer to his own question, Luria suggests that, given the principles of social development, a more appropriate method of psycho-educational evaluation might involve the investigation of what

Vygotsky termed the "child's zone of potential development" (Luria, 1961)--the range of potential development characteristic of a particular child and manifest in ability to profit from adult-provided organizational cues. Assessment of this "zone" necessitates a 3-stage procedure in which children are first presented with a task which demands that they supply a measure of organization not completely inherent in task materials. Children perform this task by themselves. Then they are invited to engage in the same or in similar tasks while the examiner provides a graded, individually tailored series of organizational assists. Finally, children are once again asked to perform in independence.

From research employing this technique with normal, LD, and MR children, one finding has consistently emerged. Appropriately aged, normally achieving children can typically provide a measure of organization to task materials on their own. LD and MR children can not. When, on the other hand, the same task is presented with increasing levels of adult organizational intervention, LD subjects often improve performance to the level of normals acting in independence while MRs seem unable to take much advantage of adult-provided prompts. Although their independent performance may be similar, in other words, LDs and MRs are distinguished by the width of their respective zones of potential development. For this reason, Soviet special educators see evaluation of the zone of potential development as a valuable tool for adequate diagnostic classification. A number of experimental studies exemplifying this technique will be described in the following review.

Experimental Psycho-educational Research on Learning Disabilities in the USSR: A Selective Review

Visual/Auditory Perception

In clinical and pedagogical descriptions of learning disabilities, the claim is often made that children's utilization of information in the visual and auditory sensory fields is inadequate. If correct, this claim seems to suggest that effective curriculum design for such children requires the specification of the locus of this inadequacy. In which of the multiple processes underlying the rapid and efficient extraction of information from a visual or auditory array do LD children experience a deficit?

Visual analysis and apprehension of distinctive features. At the level of primary visual analysis, the competence for quick visual search, the grouping of elements in the visual field, and the integration of multiple groups is presumed essential to the pick-up of higher-order visual information. One possible explanation for LD children's relatively poor ability to utilize visual materials, therefore, might be an underdevelopment in the visual search and grouping processes.

This hypothesis was evaluated by Shoshin (1972) in an experiment in which 19 LD, 23 MR, and 20 normal children aged 9-11 years were shown visual stimuli consisting of a number of identical dark round dots on a light background and asked to specify the number presented. To minimize possible effects of variation in conceptual ability, only the integers from 1 to 6, for which both the concepts and the verbal labels are highly overlearned by all subjects, were employed for recognition. In addition, to guarantee

that performance differences would reflect perceptual rather than attentional or counting speed variations, stimuli were tachistoscopically presented so as to measure the shortest exposure interval necessary for a fixed standard level of correct recognition. Thus the presentation interval, initially long enough to guarantee correct recognition, was gradually reduced to the point of chance, and then increased until the child reached the standard recognition level.

In order to assess the efficiency of search and grouping processes, two types of dot configurations were employed. A symmetric dominoe-like configuration assumed to be relatively immune to search and grouping variation (on the grounds that the pattern can be processed holistically) provided baseline standard recognition data. An asymmetric configuration with dots randomly distributed across the visual field was assumed to require maximum efficiency of search and grouping. Ratio of asymmetric to symmetric standard recognition levels was employed as the measure of relative efficiency of search and grouping.

Results of the study indicated no significant differences in standard recognition level for symmetric configurations among the three groups of children. For asymmetric configurations, on the other hand, standard recognition levels were highest for MRs, somewhat lower for LDs and lowest for normals, with the greatest between groups variation on 5- and 6-dot figures for which necessity of search and grouping is maximized. Mean ratio asymmetric to symmetric standard recognition figures for the 6-dot array, for example, suggest that MRs (6.3) find the asymmetric array much more difficult

to search and group efficiently, LDs (2.6) also find the asymmetric configuration more difficult, while normals (1.7), although beginning to approach the limit for rapid processing of asymmetrical numerical information, still perform at a reasonably high level.

Shoshin interprets these results as indicating a relative automatization of search and grouping strategies in the normal child by age 9. Very little more time is required for the pick-up and integration of simple discrete information scattered across the visual field than for the holistic processing of more highly organized material. LD and especially MR children, on the other hand, have not developed the same high level of efficiency in this basic visual processing skill. Shoshin feels, on the basis of these findings that LD children should be allowed a longer period of classroom time to familiarize themselves with visual aids and that information should be presented to LD children in well integrated, attention-capturing images rather than in small detail or through isolated elements of the visual field.

In addition to basic perceptual processes like search and grouping, a number of higher-order visual analytic abilities may be presumed to underlie children's differential adaptation to varying visual experience. For example, to benefit maximally from visual materials, a child must be sensitive to similarities and differences existing among items in the field. Important information in a picture (or in the world) is often carried by rather subtle, graded differences along dimensions such as color, shape, number, orientation, spatial configuration, etc. The child who is most perceptive at apprehending such differences profits most from visual presentations. Another

hypothesis which might help to account for some LD children's inadequate use of visual materials is that, relative to normals, their ability to notice the distinguishing features of objects, i.e., to analyze the visual display in detail (even when there are no time constraints) is underdeveloped.

This hypothesis was explored by Egorova (1969) in an experiment which took the form of an investigation of the "zone of potential development", evaluating the relative effects of distinctive feature training on the performance of children in various diagnostic categories. In part 1 of the procedure, 20 normal, 30 LD and 20 MR 2nd- and 4th-graders were shown a color drawing of a cherry tree branch and instructed to look the picture over and describe it in detail, telling the experimenter what had been drawn, how many objects there were, what were the details of shape, color, arrangement, etc. Number of features (defined in terms of parts and properties of the main drawing) described by the child was employed as a measure of visual analytic ability.

Results indicated that normally achieving subjects described 12.5 features on the average in comparison to LD and MR children who named only 6.5 and 4.5 respectively. Differences among all groups were statistically significant. In addition, classifying the feature description of children in the three groups as low (0-3), medium low (4-7), medium high (8-11) and high (12+), Egorova found that all LD children fell in the middle two categories, all normals in the top two categories and most MRs in the bottom two categories with no MR in the highest category. Of central importance, modal performance of both LD and MR subjects was the same: average-low.

In discussing these results, Egorova points out the fact that LD subjects are by no means homogeneous with respect to performance on this task. Some (typically those in the average-high category) were impulsive and disorganized in responding. "Without listening to all of the instructions, " she reports, "some of them nodded their heads indicating that they understood and hurriedly began to tell their story...In naming the features, they did not hold to any certain plan." Others (typically those in the average-low category) were not particularly impulsive but rather responded to the instructions with statements to the effect that they were unable to do the task and only began the task with additional instruction.

In part 2 of the experiment, children in all three groups were shown a teaching album containing pairs of pictures differing on a single feature (e.g., number, shape, configuration). The child was told to look at each pair and describe the difference. Children having difficulty describing a feature were assisted with a series of prompts. At the conclusion of training, the original picture of the cherry tree branch was once again presented under the same instructional conditions. After training, normals described 18.1 features, LDs 10.5 features and MRs 5.7 features on the average. Although normal children profited most from adult assistance (+5.6 features), LDs also benefited substantially (+4.0), achieving almost the original level of independent performance of normal subjects, while MRs benefited only minimally (+1.1). Furthermore, distribution of post-training description scores indicated a distinct upward shift of the distribution for normals and LDs with most normal and some LD children in the high category and the majority of LDs in the average-high category. MRs, on the other hand, despite minor

improvement, were all distributed after training in the bottom two categories.

Egorova interprets these results as support for the notion that LDs may be distinguished from MRs far more easily by their ability to take advantage of adult organizational assistance than by the level of their initial independent performance. The critical pedagogical characteristic of LD children, in Egorova's view, is their inability to perform well in independent work and their concomitant capacity for improved performance with structured adult assistance.

The pedagogical implications of this study are obvious. Teachers need to provide the LD child with experience oriented toward improving ability to make visual analyses, to perceive similarities and differences along important dimensions. In addition, as indicated by Egorova's qualitative observations, teachers need as well to concentrate on helping the child to acquire the ability to perform the task of visual analysis and to describe the results of that analysis systematically, according to some plan. Although Egorova does not specifically make the point herself, her qualitative observations strongly suggest that lack of systematicity in scanning a visual array both in terms of spatial exhaustiveness (i.e., covering all portions of the array) and conceptual structuring (i.e., beginning with global features and proceeding in an orderly way to the description of detail) may well rank with insensitivity to distinctive features as sources of poor utilization of visual material in children with learning disabilities.

Spatial organization. Adequate utilization of visual material may also require the child to structure action to reflect information existing

in the visual array. To do so, the child must employ the elements of the array as a model in constructing a plan for action. It is clear that even in the presence of adequate visual analysis, inability to convert visually apprehended information to a temporal plan of action or inability to follow an action plan even when it is provided would preclude the child's benefiting fully from visual information.

The hypothesis that LD children may find the task of converting visual information or even a verbally provided action plan into action difficult can be partially evaluated by providing children with visual, visual-verbal, or verbal models and asking them to follow these models in drawing or constructing objects in space. Zharenkova (1972) presented three series of such tasks to 20 LD, 20 normal, and 10 MR 1st- and 2nd-graders. In the first series, subjects were shown purely visual models containing all features essential for accurate performance: a) a nonsense figure made of different colored traingles, circles, and squares; b) a colored geometric mosaic of a man; c) an outline of a diamond shape; and d) a simple printed text. For tasks involing models a and b, the child was asked to construct figures corresponding to the models using appropriate materials. For tasks with models c and d, the child was asked to draw (write) a copy of the model with a pencil.

The most typical feature of LD task performance, in contrast to MRs and normals, was an extreme impulsiveness leading to numerous corrected and uncorrected errors. In text-copying, for example, LDs made seven times as many corrected and ten times as many uncorrected errors as normals and

in construction tasks, LDs engaged in a much higher rate of trial-and-error behavior (i.e., picking up an incorrect component, trying it, seeing that it doesn't match, rejecting it, picking up another, etc.) than either MRs or normals.

In series 2, the child was presented with visual models which did not contain all of the information necessary for successful performance. The additional information was incorporated in auxiliary verbal instructions provided by the experimenter. The first task of this series was similar to that of the initial series, viz., use of various colored shapes to copy a model figure, except that the model was black and white and the experimenter added a verbal instruction that all elements used in the construction should be of a different color. In a second task, the child was asked to copy a text as in the first series except that s/he was also told to underline "t" wherever it appeared.

In general, LD subjects found the first task in the second series much more difficult than its initial series counterpart. The additional processing involved in monitoring the colors and excluding colors already chosen from future selection in the absence of direct visual support by a colored model significantly increased LD subjects' impulsivity and errors. In addition, while LDs had a higher rate of trial-and-error action than of corrected errors and a higher frequency of corrected than uncorrected errors, MR performance in the same task was characterized primarily by uncorrected errors. On the second task in this series, on the other hand, LD performance was higher than in the initial series counterpart with fewer errors of either

type. Zharenkova suggests that this result is a function of increased attention to the model required by the underlining condition.

In the final series of tasks, a purely verbal variant of the colored geometric form construction task and a verbally directed complex drawing task were presented to the subjects. In the first task, the child was once again asked to construct a figure from colored circles, triangles, and squares but no visual model was provided. The order of form distribution was specified through verbal instruction alone and once again the subject was instructed to make each form a different color. In the second task, the child was asked to construct a design among squares and triangles arranged with small circles between them by drawing lines so that: 1) squares and triangles were joined only through a small circle; 2) lines were always drawn from left to right; and 3) lines had to be drawn so as to be continuous. Preliminary practice was provided in the rules after which the child was presented with a verbally described design and asked to draw it with only the verbal directions of the examiner as a guide.

Results indicated that the geometric construction task with verbal instruction alone was at approximately the same level of difficulty for LD subjects as the same task with a black and white model. Normal students, on the other hand, had no serious difficulty with this task but MRs found it much more difficult than carrying out the analagous task with a black and white visual model. In the design construction, LDs found taking all of the parameters of response into account simultaneously in order to learn the rule system very difficult. However, a majority of children in this group

who at length succeeded in mastering the rule system were able to use the rules to guide their subsequent independent performance.

Although not specifically discussed by Zharenkova, there are several alternative interpretations of LD children's relative inability to make efficient use of a visual model in organizing action. First, as suggested by Shoshin (1972) and Egorova (1969) in the studies mentioned above, analysis of the visual model and apprehension of distinctive features critical for differential response may be especially difficult for LD children. Clearly this analytic ability is prerequisite to adequate use of the model and, as such, would affect performance in these tasks. It would appear that this interpretation is at least partially supported by the large number of uncorrected errors in LD performance.

On the other hand, equally large numbers of impulsive trial-and-error actions and corrected errors, even when the visual is replaced by a verbal model, suggests that the inadequate LD performance cannot be wholly ascribed to incomplete visual analysis. In fact, corrected errors in which the child alters response as a function of comparison of the partially completed construction to features of the model provides evidence for substantial competence in visual analysis at this level among some LD children.

Another possible explanation of the LD child's difficulty with use of visual models is suggested by the high incidence of impulsive trial-and-error action. Clearly, temporary inhibition of response to the model is as much a prerequisite for adequate modeling, particularly in tasks in which more than one dimension of the model (e.g., shape and color) constrain

action, as is visual analysis. LD children may often fail to achieve the inhibition of immediate response to the model essential to completion of an exhaustive pre-response visual analysis.

Finally, a third alternative also seems plausible. Even if a child successfully inhibits immediate action to the model long enough to complete an exhaustive visual analysis and even if the child possesses the processing skills necessary for such an analysis, a problem could still occur in the conversion of visuo-spatial information (e.g., the configuration of elements in a mosaic of a man) to an appropriately organized spatio-temporal plan for construction of the figure (e.g., the shoulder must be joined to the body before the arm is attached, etc.) Unfortunately, Zharenkova's study does not provide an opportunity to assess the relative contribution of this factor.

Intersensory integration. Inadequate perceptual analysis underlying poor utilization of visual material by LD children may not be restricted to the visual domain. It has long been argued, for example, that tasks such as reading and writing which convert an aural code into a written (visual-motor) code may be particularly difficult for LD children because of their relative inability to analyze the auditory stream (i.e., to break it up into its component parts) and to match auditory components which are temporally distributed with visual components arranged in space.

The hypotheses that LD children are characterized by inadequate auditory analysis and/or relative inability to integrate information across sensory modalities and that the inabilities relate to reading/writing deficiency have been evaluated by Nasonova (1979). First-, 2nd- and 3rd-grade normal, LD and

MR subjects were given an audio analysis pre-test requiring assessment of the quantitative composition of sequences of tapping sounds followed by 4 tasks requiring audio-motor, audio-visual, visual-motor, and audio-motor-visual recoding respectively. In the audio-motor (A-M) task, children were asked to listen to a series of tapping sounds and then duplicate the series by tapping out the rhythmic structure themselves. In one sub-condition, a visual diagram portraying the rhythmic structure was present during encoding. In a second sub-condition, the diagram was present during both encoding and response. In the audio-visual (A-V) task, children presented auditorally with a rhythmic tapping series were asked to choose which of 3 visual diagrams correctly represented the rhythmic structure of the sounds. In a visual-motor (V-M) task, children were presented with visual diagrams and asked to tap out the rhythmic structure depicted; and in the final audio-motor-visual (A-V-M) variant, children were asked to draw a graphic depiction of the auditory rhythmn structure.

Results indicated greater difficulty with the auditory pre-test among MRs and LDs than among normals. Across grades, 19% of LD and only 6.6% of normal subjects experienced difficulty with simple quantitative auditory analysis. Findings from the 4 cross-modal tasks indicated a low level of performance by MRs on all tasks at all grade levels (error rates from 56% to 89.7%). At the other extreme, normal subjects performed with a high level of accuracy (error rates from .5% to 12%) at all grade levels on all tasks except A-V-M. The A-V-M task requiring the child's constructing a graphic depiction of an auditory sequence was by far the most difficult task for all subjects at all ages (error rates by grade for normal subjects were

28.5%, 27.5% and 22.5% for 1st-, 2nd- and 3rd-grades respectively). LD performance typically fell between that of MR and normal subjects. In contrast to both MRs and normals, LD error rates showed a substantial decline with grade-level on all tasks, with greatest improvement between grades 2 and 3 such that 3rd-grade LD scores were almost comparable to those of normal subjects. Additionally, the author indicated much greater within-grade inter-individual variability in performance among LDs, a tendency for LD subjects in the A-V task in which a visual display matching an auditory input must be chosen from a set of three variants to err when position was the feature distinguishing the visual variants (e.g., /... . ../. ... ../.. . .../), and substantial improvement for LD and normal but not MR subjects when a visual aid was present for encoding (greater still when present for encoding and response) during the A-M task.

In a final portion of the study, using analysis of words and sentences presented orally and in written form as a measure of analytic ability and classroom achievement in reading and writing as a measure of academic proficiency, Nasonova reported a general tendency for inadequate audio analysis to be related to the most severe reading-writing deficiencies. More moderate reading-writing problems, on the other hand, appear correlated with moderate audio analytic ability but proncounced difficulty in correlating sounds and letters (in the visual presentation).

The finding that LD children have difficulty with cross-modal matching replicates a persistent finding in the American literature (Birch & Belmont, 1964, 1965a, 1965b). More interesting, perhaps, is the discovery of substantial

improvement in LD cross-modal performance on all tasks between 2nd- and 3rd-grades and the correlation between inadequate audio analysis and severity of reading-writing deficiency. Unfortunately, these results are, at best, very difficult to interpret. Improvement in LD cross-modal matching at 3rd-grade may be a function of rather than a prerequisite for training in reading and writing. The author's failure to report specific within-grade correlations between reading ability and cross-modal performance makes it impossible to assess the extent to which this relation may exist apart from the effect of quantity of training in reading and writing. Similarly, although the correlation between severity of reading-writing deficiency and inadequate auditory analysis is suggestive, the fact that the measure of inadequate audio analysis involved an oral language task rather than cross-modal tasks of the sort employed in the first portion of the study seriously constrains the generality of the conclusion.

Attention

Differential distractibility. Another characteristic commonly mentioned in clinical and psycho-educational observations of LD children is their relative distractibility. Given the necessity for voluntary attention to academic tasks and the concomitant need for resistance to the distractive effects of high salience background events (e.g., conversations, noise) in the classroom, this poses a particularly critical problem for learning disabilities research. Peresleni (1972) attempted to document the differential distractibility of LD children by presenting 15 LDs, 16 normals, and 12 MRs, 8-9 years of age, with a series of vibrotactile signals (reliably above

threshold) to one or the other wrist. The subject was instructed to press a key as soon as vibration was detected and to use the finger of the hand which felt the vibration. Most importantly, however, subjects were asked to follow these instructions while listening via headphones to noise, to music, or to a story called "Masha and the Bear".

Response latency and errors of omission and commission were recorded. Results indicated uniformly shorter latencies for normals than for either LDs or MRs. In addition, while normal subjects' latencies were relatively unaffected by distraction condition, LD and MR latencies rose sharply with the story distraction, MR latencies showing the steepest rise. Errors, on the other hand, reached a significant level only with MR subjects and only in the story condition. Finally, comparison of the mean latency to the first ten stimuli with the mean latency to the last ten stimuli as a measure of growing interest in the distractor over time indicated all groups slowing in and only in the story condition and LD subjects slowing the most (-120 msecs) followed in order by MRs (-112 msecs) and normals (-61 msecs).

A number of conclusions might be drawn from the pattern of results in this experiment. First, only the story distractor disrupted performance of the three groups, an effect much more marked with LD and MR than with normal children. Peresleni notes that this differential distraction is not a function of lowered interest in the story in normal subjects. In fact, when the experiment ended prior to story completion, normal children asked much more frequently to hear the conclusion than did LDs or MRs. Apparently, therefore, meaningful background material acts as a powerful distractor and a more powerful distractor for LD and MR children than for normals.

Second, although the latency (mean and variability) of LD performance was more like that of MRs than of normals, LD subjects, unlike MRs, were nevertheless able even with the story distraction to maintain accuracy of response to the signals. Assuming with Peresleni that size of the latent period reflects processing speed, it might be argued that LDs slow their processing to maintain accuracy under distraction. On the other hand, it is also well to keep in mind that LDs and MRs both react more slowly than normals even in the simple noise condition. Since subjects might be assumed to habituate quickly to noise, these relatively slow reaction times could suggest generally slower sensory information processing in LD and MR children. If supported, this notion would seem to have a critical implication for characterization of learning disabilities. When simple, discrete, and reasonably well spaced stimuli are presented for processing, LD children may be able to maintain accurate performance even with distraction if they slow an already slow processing rate. In the classroom, where information is presented serially at high rates requiring continuous coding and storage, this characteristic would put the LD child at a serious disadvantage relative to normal peers

Memory

Recall and recall strategies. As information is extracted from the perceptual field, it must be coded and stored in a fashion which facilitates future retrieval. Information unavailable to retrieval is unavailable for the organization of future action. The hypothesis that LD children are less able than normals to access stored information has been tested by Egorova (1972).

Eighteen 1st- and 22 2nd-grade LD children and 20 normal 2nd- and 3rd-graders (all aged 9-10) were briefly shown each item in a set of 20 pictures of common objects and, at the completion of the series, children were asked to recall as many objects as they could. The same set of 20 pictures was then presented 4 more times with a recall session following each presentation. Finally, following the fifth trial, the entire 5 trial procedure was repeated with a second set of 20 pictures.

As anticipated, average recall for normal subjects (14.5 items/trial) exceeded that for LDs (11.9 items/trial). More importantly, LD subjects exhibited a much higher tendency than normals to lose items across the five trials which had been correctly recalled on some prior trial. Thus, for example, only 1 of 7 words recalled by normal children on trial 5 was a "new" word, a word first recalled on that trial. For LDs, on the other hand, 1 of 4 words recalled on the final trial was a "new" word. Furthermore, while trial 5 was the point of maximal recall for almost all of the normal subjects, only 50% of LDs peaked at this point, 32.5% reaching maximum recall on trial 4 and 17.5% on trials 2 or 3. Taken together, these findings suggest that LD subjects, having once recalled an item, were much more likely than normals to fail to retrieve that item in favor of a new item on some subsequent trial.

In addition, Egorova, computing the ratio of mean recall for the first versus the second set of 20 pictures as a measure of mnemonic stability, found recall declining much more frequently among LDs than among normals (37.5% vs. 10%) and improving much more frequently among normals than LDs (35% vs. 12.5%).

Similarly, while normal subjects categorized 40% of material recalled on trial 5 of the first set and LDs 20%, this percentage climbed to 57.5% for normals following trial 5 of the second set but declined to 10% for LDs. If categorization is taken as indicative of storage and retrieval efficiency, this finding would appear to suggest that lowered LD memory performance may perhaps be more readily traced to poorly developed storage and retrieval techniques than to any absolute differences in memory capacity.

A similar conclusion in a slightly different mnemonic domain can be drawn from a study by Podubnaya (1975) evaluating LD and normal children's use of associated items as retrieval prompts in an incidental learning situation. Forty LD and 20 normal 1st-graders were presented with 4 associative matching tasks separated by 3-week intervals. On each task, children were presented with each member of a set of primary items for which they had to choose or to generate an associated item. In the first task, the primary items consisted of 15 pictures of common objects. Associated items had to be chosen from a separate pool of 20 simultaneously displayed pictures of objects. In the second task, a series of 15 words constituted the primary items while associated items were again chosen from a (different) pool of 20 pictures of objects. In task 3, primary items once again consisted of pictures of objects but children were required to generate words (i.e., object names) as items associated with each picture in the primary series. Finally, in the fourth task, a word series constituted the primary material and children generated associated items by thinking of a word for each word presented. Instructions for each task omitted any reference to future recall. However, at the completion of each task,

children were asked to recall as many items from the primary series as they could.

Results indicated significantly greater recall among normal than LD subjects with a relatively parallel variation by condition. Normal children typically recalled about 50% of the primary material when primary and associated material differed by type (i.e., picture-word, word-picture) but only 40% when it did not (i.e., picture-picture, word-word). Percent recall for LD subjects under the same conditions was 30% and 25% respectively. More importantly, while normal subjects had no difficulty discriminating between primary (subject to recall) and associated items at recall, LD students made a large number of confusion errors on all tasks (37%, 42%, 37% and 53% on tasks 1-4 respectively).

This finding suggests that, unlike normals, LD subjects failed during storage to retain the distinction between primary and associated item categories, despite the fact that this would appear to be a fairly elementary categorization since it is based on the subject's own activity toward the items. Podubnaya, in commenting on the actions of subjects during the recall period, points out that normal students often thought aloud, frequently engaging in backward reasoning from associated to primary material. LD subjects, on the other hand, tended to name a few items quickly, often those which seemed to attract their special attention, and then to stop, rarely using associated items for self-prompting. This seems hardly surprising in view of the fact that this particular retrieval strategy appears to require maintenance of the distinction between primary and associated items in storage, a distinction which LD subjects apparently do not retain. Once again, then, the

lowered memory performance of LDs appears to be a function of inadequate categorial storage and retrieval.

At least two explanations can be advanced for this phenomenon. First, poor categorial storage and retrieval may reflect a fundamental inability to sort by category (i.e., to see objects as categorial instances). Second, even should ability to categorize be adequate, poor categorial storage and retrieval might still result from a failure to employ categorial recoding as a mnemonic technique. The first hypothesis was directly and the second indirectly evaluated by Lutonyan (1977).

Forty-four LD and 20 normal 2nd-graders were presented with 20 color pictures of familiar objects representing each of five situationally defined categories (e.g., a medical category defined by pictures of a doctor, a bandage, a thermometer, and a hot water bottle) and asked to sort them so that "the pictures that belong together are placed together." Following the sorting procedure, 22 of the LD subjects were given a six-lesson category sorting training procedure in which children were given practice sorting pictures into situationally defined groups. At the conclusion of training, children were presented with a picture recall task in which they were asked to look at the pictures and try to remember as many as they could. They were also told that they could rearrange the pictures anyway they liked while looking at them. A recall test followed immediately.

Results from the category sorting test indicated normal subjects sorting 84% of the pictures into a correct 4-picture group. 7.5% and 6.0% of the pictures were sorted into 3- and 2-card groups respectively; and only 2.5%

of the pictures remained unassigned to a group. LD subjects, on the other hand, sorted only 17.4% of the pictures into the correct 4-object group. Instead, LDs created 3-object groups with 14.3% and 2-object groups with 31.9% of the pictures, leaving 36.4% of the cards unassigned. Lutonyan interprets these results as indicating a low level of generalized understanding of the concept of "group" among LD children.

Results from the post-training recall test, however, suggest that this ability can be developed in instruction. LD subjects who received training in categorizing pictures recalled 88.5% of the items in the post-training free recall task. Untrained control LD subjects, by contrast, recalled only 63.5%. Furthermore, of the 88.5% of the items recalled by trained LD subjects, 68.3% were recalled in a 4-object group. Only 12.3% and 6.4% of objects were recalled in 3- and 2-object groups respectively and only 1.5% were ungrouped. Among untrained controls, on the other hand, the largest percentage (19.2%) of objects were recalled ungrouped. Only 18.8% of recalled items were recalled in a 4-object group and 11.9% and 13.6% were retrieved in 3- and 2-object groups respectively. These findings suggest not only that LD subjects can be taught to group objects according to situational relations but that grouping, when employed at storage, will be reflected in both the overall level of recall and the degree to which recalled items are grouped.

Memory for connected discourse. The mnemonic effects of training LD children in object grouping, as just described, suggest that accuracy of recall is a function of underlying cognitive abilities--in this specific task, of the ability to conceive objects as instances of certain categories. However, it might be expected that the role of comprehension in memory and the relation

of comprehensional deficits to lowered memory performance in LD children would be even clearer in mnemonic tasks of greater complexity such as memory for connected discourse. One of the most interesting studies in the Soviet defectological literature centers on this issue. Tsypina (1974) engaged 11 normal and LD 1st-graders and MR 2nd-graders in a semi-structured discussion in which children were asked to tell the experimenter everything they knew about dandelions. Numbers of features spontaneously mentioned by each child were recorded. Next, children were read a story called the "Golden Meadow" which revolves around a dandelion meadow which changes color in the morning and evening as the dandelions open and close with the sun. An understanding of the story line depends on apprehending the causal-temporal relations between time of day, the opening and closing of the dandelions and change in color of the meadow. To call attention to the critical component of the theme, the dandelions' opening and closing, the story employs a metaphor involving the opening and closing of the human hand to reveal fingers or roll into a fist. At the completion of the story, children were asked to retell the tale in their own words. Following story recall, another semi-structured discussion was held and several questions asked: What happened to the meadow? Why did the meadow change color? What does it say in the story about a hand? Finally, children were once again asked what they knew about dandelions.

Results from the first discussion indicated that while normal students were capable of specifying 5-6 dandelion features, LDs were able to specify only 1-3 and MRs only 1-2 characteristics of dandelions. No child in any group initially indicated dandelions' opening and closing with the sun as a feature.

Story recall was assessed by dividing the story into 5 sections and recording the number of sections children included in their retelling. By this index, LDs and normals generally performed at a high level. Although there was a bit more variability among LDs than normals, most members of both groups included all 5 sections of the story in their retelling. MRs, by contrast, rarely included more than 3 of the 5 sections and often retold these out of order.

To evaluate the extent to which the high level of recall among LD students reflected story comprehension, Tsypina analyzed replies to the various post-recall questions. All but one of the normal subjects were able to explain why the meadow changed color. Of 11 LDs, on the other hand, only 5 appeared to understand the phenomenon and they were less than completely clear, often describing the meadow rather than the dandelions opening and closing. The remaining 6 LD children totally disregarded the story line in replying to questions concerning the meadow changing color, suggesting, for example, that it is the heat of the day which causes the meadow to turn yellow. Finally, none of the MRs demonstrated comprehension of the phenomenon. In addition, while all of the normal students appeared to comprehend the relationship between time of day and the change of color of the meadow, only 9 LD and 4 MR subjects gave evidence of comprehending this aspect of the story line. Finally, neither MRs nor the majority (9) of LDs seemed to understand or even pay attention to the metaphor of the hand opening and closing which had been incorporated into the story to facilitate comprehension. Over half of the normal subjects, on the other hand, appeared to understand and could even explain the metaphor.

Thus it would appear that the relatively high level of story recall among LD subjects did not indicate similarly high comprehension. In fact, recall by LD subjects appears to have been pretty much a rote affair. If this is indeed the case, it might be expected that novel information, even when available to recall for purposes of story retelling, might fail to generalize to a different task. This expectation appears to be supported by the results of the final portion of the procedure in which the children were once again asked to tell what they knew about dandelions.

In this final task, most children complied by repeating features previously listed in the pre-story discussion. MRs, in fact, stopped at this point, content with a repetition of past performance. Normal students, on the other hand, typically added one or two dandelion features to their discussions and LDs added from 3-5 features not previously mentioned. As a result, LD performance in the final discussion was comparable to that of normal children in the pre-story task. Of particular importance, however, the characteristics of dandelions added by LD subjects in the final discussion were not features taken from the story line since by and large they were not features which had been mentioned in the story. Additionally, no LD or MR subject included the one new characteristic of dandelions (opening and closing with the sun) which had not only been mentioned but which was central to the story. Among normals, though, 9 out of 11 children were able to incorporate this new feature into their concept of dandelion. In fact, this feature accounted for most of the increase in normal subjects' description scores.

In Tsypina's view, these results indicate a deficit in voluntary retrieval in LD children. Apparently, at the time of the initial discussion,

LDs knew a good deal more about dandelions than they were able to recall. Only after the story and the discussion which may be presumed to have functioned as extended retrieval cues were LDs able to access their full knowledge of dandelions. Furthermore, Tsypina relies on the fact that LDs were unable to use the added characteristic of dandelions opening and closing in their final descriptions to infer that LD story recall was based more on rote repetition than on thematic comprehension and that comprehension is prerequisite to information transfer. This conclusion is bolstered by the fact that the 9 (of 11) normal children who added the additional feature to their dandelion descriptions were the same 9 children who demonstrated the highest level of understanding of causal-temporal relations in the story line.

Cognitive Function

Most generally, "cognitive function" refers to the acquisition and use of knowledge. What knowledge about the world and themselves do children possess? How did they acquire that knowledge and how do they use knowledge to guide action? Given this view of cognition, issues of perception, attention and memory are largely inseparable from issues of cognition. Knowledge of the world comes through the senses. The more organized the information pick-up, storage, and retrieval, the broader and deeper knowledge becomes. From the Soviet view, however, it is just as true that the broader and deeper knowledge of the world becomes, the better organized and more efficient the actions of information pick-up, storage and retrieval. Knowledge, in other words, is employed to structure that activity. Thus, for example, children's knowledge

of the left-right progression of the orthographic code depends on their picking up enough ordered information about orthography that they can induce the left-right progression. This, in turn, requires the prior development of a certain level of visual analytic ability. On the other hand, once children come to realize that orthography is coded from left to right, their ability to extract information from the orthographic code will be greatly enhanced. Knowledge, in short, will facilitate visual analysis. Thus, knowledge, perception and action exist in constant interaction in the determination of human learning.

Concept formation. Given the above view, the deficits in abilities such as visual search and grouping, visual analysis, spatial organization, intersensory integration, voluntary attention, and organized storage and retrieval in memory which appear to characterize LD children previously described might be expected to be both a source and a reflection of a relatively low level of knowledge acquisition among LDs. The hypothesis that LD children possess a lower level of knowledge about their world than normal children was assessed by Shevchenko (1974).

Twenty 7-year-old LD and normal children were engaged in semi-structured individual discussions of a variety of family-related topics ranging from parental occupation to the formation of the Russian patronymic. In general, knowledge exhibited by LDs, as opposed to normals, seemed imprecise and incomplete. Thus, for example, though children in the LD group could specify the general field of their parent's employment, they were typically unable to elaborate on the parent's professional duties in that field. Similarly, LD subjects rarely had realized that the patronymic was formed from the

father's first name, despite the fact that they typically employed the form in their social speech. In addition, while an indication at the end of the discussion to the effect that the topic would be discussed again in the future spurred a spontaneous search for relevant information in almost half the normal group, it had little effect on the LD students.

Shevchenko interprets these results as supporting the hypothesis that the level of "everyday" knowledge in LDs is significantly below that of their normal peers. With reference to the Tsypina (1974) study involving children's knowledge of dandelions described above, however, it should be noted that semi-structured discussion does not always allow one readily to distinguish between absence of knowledge and difficulty in the voluntary recall of information. Thus, lack of specific detail concerning parental occupational duties does not necessarily imply lack of knowledge. On the other hand, the finding that LD 7-year-olds have not spontaneously realized the sense of the patronymic can hardly be attributed to deficit in voluntary recall since the patronymic itself acts as a retrieval cue. Rather, this suggests a relative deficit in LDs in the ability to abstract relations that lies at the heart of concept formation.

Such a deficit in LD children's abstractive capacity, when combined with a demonstrated difficulty in voluntary recall, might be presumed to result in LDs exhibiting a relatively impoverished active vocabulary. This possibility was assessed in a recent 3-part study by Shevchenko (1976) in which children were asked: 1) to specify instances (i.e., object names) corresponding to abstract concepts (i.e., category names); 2) to generate category names for

sets of pictures grouped by category membership; and 3) to specify features employed as the basis for visual discrimination. In the first task, 30 LD and 30 normal 1st-graders were presented, over several sessions, with 27 categories and asked to name objects belonging to the category (e.g., plants, animals, toys, tools, musical instruments, etc.) In the second task, two groups (LD and normal) of 10 seven-year-olds were shown 162 pictures of objects clearly divided into 27 categories and the children were asked to name each group and then to name the objects themselves. Finally, 20 LD and 20 normal 1st-graders were shown the "bird" group and were asked not only to generate the category name and to name the individual objects but as well to describe how they recognized (i.e., discriminated) each picture.

Results from the instance specification task indicated that normal 1st-graders were able, on the average, to name 8 object instances per category in contrast to only 3.6 for LDs. Furthermore, although error rates for both groups were generally low, LDs made more errors (7.8%) than normals (1.5%). Typically, these errors consisted of overgeneralizations or, among LDs but not normals, the provision of lower-order abstractions (e.g., "vegetables" for "food") in place of concrete instances. In task 2, LD children generated correct abstract category names for only 50% while normal students were able to provide correct abstract labels for 83% of the trials. Errors on this task generally involved inability to provide any category label or use of a function statement (e.g., "things to fix things with") or plural form of a concrete name (e.g., "butterflies") instead of abstract category names ("tools" or "insects" respectively). Comparison of the results from tasks

1 and 2 suggested that specification of instances was typically easier than category labeling and particularly so for LD subjects for whom the generation of abstract terms was especially difficult. This seems to suggest that LD children possess certain lexical items passively (e.g., "sporting goods") which they are incapable of generating on demand.

In the final task, 12 of 20 normal students but none of the LDs were able to adequately specify the features on the basis of which they were able to distinguish among the various birds. Shevchenko suggests that when normal children are asked to describe distinctive features (in answer to the question "how did you know this was a...?"), they appear to have a clear and distinct image of the bird in mind which they then relate to the picture. LD children, on the other hand, appear to become much more caught up in the specific picture in front of them, often naming features which attract their immediate attention, whether or not they are relevant to a discrimination (e.g., "its black" when all birds are black). In Shevchenko's own summary, LD children "are distinctly incapable of systematically examining an object, picking out and naming its parts, or determining its color, shape, and spatial relationship...Even very widely known verbal descriptions relating objects and their spatial parts were absent from the children's speech. Instead, the children would usually use adverbs such as 'there' and 'here'..."

Pictorial Comprehension. The implication of the above research is that LD children, even when they know that objects go together on the basis of some common underlying characteristic or when they know to distinguish between objects on the basis of variation along some feature dimension, may still be

unable to represent what they know to themselves or to others by embodying that knowledge in a linguistic form. Knowledge, in other words, remains tacit, intuitive, unavailable to representation. Yet these tasks are relatively simple. One cannot but wonder, when a representational deficit appears on tasks of this sort, how much more serious that deficit might prove to be when more complex comprehensional tasks are involved. One might expect, for example, that LD children would find the generation of verbal descriptions reflecting the logical, temporal, spatial and other relations in a complex picture-with-a-plot even more difficult than the generation of category or instance names. This hypothesis was evaluated by Tsymbaliuk (1973) in an investigation employing the general "zone of potential development" format.

Thirty 8- and 9-year-old LD and 7- and 8-year-old normal students were shown a picture in which a flock of doves are nested on the roof of a shed. A cat is creeping up on the doves unnoticed. A boy is attempting to put up a ladder intending to divert the cat from the doves; but goats are emerging from the door of the shed, hindering the boy and threatening to knock over the ladder. Children were told to look the picture over as carefully as possible and describe what was happening.

Descriptions were rated in terms of 4 categories: I--not a single causal relation (e.g., cat-doves, boy-cat, etc.) is mentioned and the critical features (e.g., pose of the cat, orientation of the boy) are only poorly understood; II--one causal relation is mentioned but child generally only lists objects and actions; III--one causal relation is omitted and the sequence of events

is poorly elucidated; IV--description is adequate to the plot, all 3 causal relations are noted and integrated into a single, unified theme.

Results from the initial description were distributed as follows: Among LD subjects, 3, 14, 8, and 5 children were assigned to categories I-IV respectively. Mean category score for the group was 2.5. For normal students, on the other hand, there were no category 1 descriptions and 6, 10, and 14 children were assigned to categories II-IV respectively. Mean category score for the normal group was 3.3, differing significantly from LDs. Thus, although there is a sizeable overlap in the performance distribution of the two groups, it is clear that on the whole normal students were better able than the LDs to integrate the information in the visual array to produce a coherent verbal representation of the plot.

The second part of the procedure invclved training in which children at levels I-III on the initial task were shown additional pictures depicting sub-stories of the main plot. These pictures were shown to the children in three sequential stages, with experimenter assists progressing from a bare minimum to direct demonstration. The first set of training pictures presented the characters in the main picture (doves on roof, cat creeping, goats emerging, etc.) but each character was portrayed separately with no unifying plot. The child was told to look the pictures over in sequence and describe them. This minimum level of training was included on the theory that for some children poor performance on the original task might have been a simple function of inadequate visual analysis. The child might have neglected one or another of the components of the picture and have thus failed to comprehend the plot as

a whole. At the completion of minimal training, the children were shown the main picture and again asked to tell what was happening. Children who did not achieve a category IV plot description at this point were given a second, intermediate level of training.

Intermediate training presented children with pictures isolating single causal relations (e.g., goats emerging from the shed and rushing at the ladder). Children were shown only those pictures appropriate to causal relations previously omitted in description. This was followed by another opportunity for the child to describe the plot of the main picture. Lastly, any child whose explanation was still below category IV was provided with a final training session in which a set of 5 sub-pictures clearly depicting the serial order of events in the main picture was shown to the child. The child was told to describe the events thus portrayed and then once again shown the main picture and asked to describe the plot.

Results of training and retesting suggested that minimal training (simple pictures of isolated characters) was effective primarily for normal students. Following this procedure, no normal student remained at level II and 4 had moved from III to IV. Among LDs, however, minimal training affected only 4 students, 2 who moved from II to IV and 2 who crossed from III to IV. Intermediate training (isolating binary causal relations) assisted all of the remaining normal subjects to achieve a category IV description. Among LDs, however, with a sole exception, only those children already at level III managed to achieve category IV descriptions after intermediate training. The remaining LDs (and only LDs) required the final, most explicit training experience in order to produce level IV descriptions.

In discussing the total pattern of results from this study, Tsymbaliuk suggests that among LD children, just as between LD and MR, there exists a wide range of individual differences in zone of potential development. Thus, for example, although the measure of initial performance failed to differentiate among the 14 LD subjects whose descriptions fell into category II, the results of training suggested that some of these children were capable of rapid progress with minimal assistance while others improved their performance only very slowly, requiring a much higher level of adult intervention. The author concludes from this that appropriate educational placement requires assessment techniques which are sensitive to individual differences of this sort, techniques, in other words, which can measure the zone of potential development.

Although Tsymbaliuk only indirectly alludes to this fact, there is an additional dividend to be gleaned from training experiments of this type. The provision of systematically ordered assistance to the child provides the experimenter with the means of localizing performance deficits. Thus, for example, transition from category II or III to adequate category IV description after initial training suggests that for some (primarily normal) children, the initial failure to integrate plot elements into an adequate description can be traced to incomplete visual analysis. When the child was forced to attend to the action features of each character in the plot, an immediate integration of the total theme emerged. The fact that improvement in plot description was brought about in all of the remaining normal and many LD children by intermediate training would seem to indicate that some children have difficulty in

extracting specific causal pairs from the welter of information in the array. Although both causally related characters are perceived, they are apparently not perceived in relation to one another. Intermediate training functions by forcing the child to attend to the binary interdependence among certain pairs (e.g., cat will eat the doves, boy will scare away the cat), pairs from which the total plot must be constructed.

Lastly, the failure of some LD children to generate category IV descriptions, even with intermediate training, suggests that the transformation of simultaneous visual information into a plan for sequential verbal output may be extremely difficult for LD students. Although the three binary causal relations constituting the plot elements may be apprehended, the child may be unable to integrate them into a single temporal theme. This hypothesis is supported by the fact that most of the remaining LD subjects were able to produce category IV descriptions after exposure to the sequence pictures. Presumably, these children required a visual portrayal of the temporal sequence in order to produce a sequential-temporal verbal representation of the plot. This interpretation is congruent with the Zharenkova (1972) study previously described in which LD subjects had difficulty with the visuo-spatial to temporal-sequential transformations involved in using a visual model to construct a design.

Implications of Soviet Research for American Theory and Research

In both the general theoretical orientation of Soviet psychology and the specific psycho-educational research just described, a number of concepts and findings can be identified which appear to have implications for American

research and practice in the area of learning disabilities. Certain of these implications are theoretical; others are methodological or instructional. In a few cases, these implications have been explicitly drawn by Soviet theorists. More often, they are only implicit in the form or in the content of Soviet work; and, occasionally, they are to be drawn not from what Soviet researchers have done but from what they have failed to do.

In order to integrate the various implications to be drawn from Soviet work in such a way as to highlight their thematic import, this section will be organized around three major points: 1) Learning disability can be construed as a deficit in one or more of the processes underlying knowledge acquisition. 2) Learning disability is not a unitary syndrome but varies by process among individuals and by task within individuals, thereby necessitating process and task diagnostics. 3) As a consequence of points 1 and 2, process analysis and process-oriented instruction as competence-related must be supplemented by task analysis and task-oriented instruction as performance-related. Furthermore, the transferability of process-oriented instruction requires developing the child's conscious awareness (reflective knowledge) of processing techniques and strategies as both task-general (i.e., transferable) and task-relevant (i.e., applicable to instances of classes of tasks).

Learning disabilities, process deficits, and implications for theory. As previously described, the general orientation of Soviet psychology is cognitive. Knowledge of the physical-social world is viewed as being organized by human action. Action in the physical-social world is organized by human knowledge. Knowledge, therefore, reflects general patterns of organization inherent in

practical action. Action, in turn, reflects the generality of knowledge. One implication of this view is that both knowledge and action are trans-situational. The child who knows how to organize activity in a knowledge-guided fashion in one situation will be able to organize that activity appropriately in other similar situations.

This perspective leads rather directly to a conception of psychological competence for the acquisition of knowledge (i.e., learning) in terms of underlying processes rather than in terms of task-dependent products and, correlatively, to a view of learning disabilities as a delayed development in one or more of the processes critical for knowledge acquisition. Thus, Soviet researchers suggest that, relative to their normally achieving peers, LD children show deficits in visual search and grouping (Shoshin, 1972), extraction (Egorova, 1969) and systematic description (Egorova, 1969; Shevchenko, 1976) of visual distinctive features, division of attention (Peresleni, 1972), categorial recoding of information (Egorova, 1972; Podubnaya, 1975, Lutonyan, 1977), voluntary retrieval (Egorova, 1972; Podubnaya, 1975; Tsypina, 1974), and translation of auditory non-linguistic, linguistic, and visuo-spatial information into plans for serial action (Zharenkova, 1972; Nasonova, 1979) . In other words, learning disabilities appear to involve deficits in one or more of the processes geared to knowledge acquisition, viz., the extraction, storage, retrieval, and utilization-for-action of information about the world. Since these processes both reflect the level of the child's knowledge and lead to its further development, it is not surprising that Soviet research also reports a lower level of everyday knowledge (Shevchenko, 1974) and of

spatio-temporal-causal comprehension (Tsypina, 1974) in LDs than in normals.

Despite the Soviet emphasis on underlying processes, however, review of the Soviet learning disabilities literature makes it apparent that Soviet psychologists are no closer than their American colleagues to providing a well-supported general theory of the integrated system of processes involved in knowledge acquisition. Yet without such a theory, the above list of process deficits in LD children remains exactly that, a list. It seems hardly possible that either a thorough understanding of the nature of learning disabilities or the design of systematic remediational instructional programs will progress very far in the absence of an integrated general cognitive theory of learning. If there is one primary implication to be drawn from all of the preceeding material, it is that research and theoretical work oriented toward the provision of an adequate general theory of learning must be an essential feature of future, more specific work in learning disabilities.

Individual differences, learning disabilities, and implications for differential diagnosis. Lack of an adequate, general theory of the integrated system of processes underlying knowledge acquisition constrains not only our understanding of the nature of learning disability as a variation from the norm; but, as importantly, it limits our understanding of learning disabilities as variable by process among individuals and by task within individuals. In the absence of an adequate general learning theory, in other words, there is no systematic framework for generating hypotheses concerning possible individual differences in process deficits among children who are grouped primarily by virtue of common failure at standard academic tasks rather than by virtue of a common psychological characterization.

One obvious effect of this theoretical vacuum is the peculiar co-existence in the same research report of statements in the results section stressing the variability among LD children with respect to almost any given process under study with statements in the methods section describing the LD subject sample as though it was a monolithic group characterized by a unitary syndrome. Soviet research illustrates this tendency no less than American research. Thus, for example, Egorova (1969), discussing the results of the feature description (cherry tree) task previously described, stresses the wide variations in impulsivity and systematicity of description observed among LDs. Tsymbaliuk (1973) makes an even stronger case for variability among LDs. Using the "zone of potential development" format to investigate aspects of children's comprehension of a visual plot, Tsymbaliuk suggests that LD performance not only varies widely in initial plot description (3 children in category I, 14 in II 8 in III, and 5 in IV) but LDs also manifest substantial individual differences in "zone of potential development." Of the 14 subjects in category II, for example, 2 moved to category IV with minimal training, 1 with intermediate training and the remainder required maximal training. Nonetheless, in these as in all of the Soviet studies reviewed, subject selection fails to reflect this individual variation. Never does one find a study in which one of the subject groups is constituted by a sub-set of children experiencing academic problems specifically chosen on the basis of a clear deficit in a pre-identified basic process.

The reason for this is obvious. Conceptualizing individual differences in learning disabilities requires a general theory of learning capable of serving

as a basis for individuating process deficits. However, there is a further implication. Even with a general theory, adequate specification of individual differences in process deficits would still require adequate, theoretically justified, process diagnostics. Efforts to develop general theories of the process system, in other words, must be accompanied by efforts to develop techniques of evaluating process competencies and variations in process competence. Not only is this prerequisite to the provision of empirical support for any theoretical model; but it is necessary as well for differential diagnosis and individualized instructional programming.

With respect to diagnosis, one very specific technique which is frequently encountered in the Soviet literature and which seems to offer a powerful method for differential competence evaluation is that of the "zone of potential development." In contrast to standardized, product-oriented psychometrics, psycho-educational assessment of the zone of potential development employs a 3-stage, quasi-standardized, process-oriented procedure. Children are presented with a task that demands that they supply a degree of organization to task materials. Initially, children are asked to perform the task themselves. Then they are invited to engage in the same or in similar tasks while the experimenter provides a graded, individually tailored series of organizational assists. Finally, children are once again asked to perform alone. As is emminently well-illustrated by the Tsymbaliuk study, the provision of systematically graded assistance to the child offers the experimenter a means of localizing process deficits by inference from the form of adult-provided assistance necessary to bring about a qualitative shift in the structure of the child's

performance. Development of process diagnostics of this type would appear likely to facilitate (as well as to be facilitated by) the generation of adequate process theories.

Process deficits, task analysis, self-development and implications for instruction. From the Soviet psycho-educational standpoint, however, neither process theories nor process diagnostics are ends in themselves. On the contrary, they are the means to provision of adequate process-oriented instruction. Soviet educational programming is, therefore, heavily oriented toward process training (Wozniak, 1975). To a certain extent, the same can be said of American educational programming. However, as is well known, both the principle of process-oriented instruction (Mann, 1971, 1974, 1979) and the practice of current process training (Cohen, 1969; Hammill & Wiederholt, 1973; Sedlak and Weener, 1973) have been criticized in the American special education and disabilities literature. Typically, these arguments take one of two forms. In one form, notions such as "psychological competence", "ability," and "underlying process" are criticized (Mann, 1971; 1979) as metaphysical, non-scientific, a reinvocation of faculty psychology, or, worse, a modern-day phrenology. This argument rests on the assertion that the hypothetical constructs of psychology (constructs such as "knowledge", "cognitive structure", "competence", "ability", and "process") are actually of the nature of intervening variables, fictions generated for the theoretical convenience of the psychologist and of "a different order of reality than physical variables" (Ghiselli, quoted by Mann, 1979). If one takes this point of view, the implications are obvious. Educators would do well to abandon

process instruction since it makes no sense to expend limited resources in the training of "convenient fictions."

Although it is far beyond the limitations of this paper to deal with this argument in any detail, it should be pointed out in passing that this view not only runs directly counter to the Soviet psycho-philosophical position, but is based on a thoroughly outdated version of philosophy of science. In the Soviet view, knowledge as psychological process is a guide to action (i.e., an ability to act in a certain fashion) in a real, existent world. As such, psychological process is granted no less a reality status than is the world in which people act. People act in the world and people know about the world. Knowledge, action, and the world are all real, existent entities. Our theories of knowledge may employ hypothetical constructs and our theoretical propositions concerning knowledge may or may not constitute good theories (and, in fact, we have reason to believe that they do not constitute good theories), but neither of these facts in any way reflects on the reality status of the object (viz., knowledge, ability, process) about which the theory is constructed.

Similarly, although western philosophy of science is at variance in a number of fundamental respects with the Soviet psycho-philosophical position, a statement to the effect that the hypothetical constructs of psychologists are of a "different order of reality than physical variables" is seen to be misguided, even from the perspective of contemporary western theory of scientific explanation. Specifically, such an assertion badly misconstrues both the nature of physical variables as theory laden (Hempel, 1966) and the epistemological status of cognitive competence theories (Pylyshyn, 1972). As

Hempel points out, it is in the nature of scientific explanation that theories construe "phenomena as manifestations of entities and processes that lie behind and beneath them (p. 70)." These "entities and processes" are represented in theoretical statements by hypothetical constructs and these constructs are neither more nor less real in physics than they are in cognitive competence theories. It is reasonable (and necessary) to criticize the available theories of underlying psychological process as inadequate. It is not reasonable to criticize such theories as unscientific.

This brings us to the second form of the process-instruction critique. Process-oriented instruction often fails to demonstrate a measurable impact on the classroom learning it is hypothesized to underlie. This is a serious criticism. It deserves serious consideration, particularly in light of the suggestion that a primary implication of the Soviet approach for future American research and practice is that such research and practice should be at least partially process-oriented. In order to provide a framework for considering possible explanations for the oft-documented failure of process training to impact classroom learning tasks, it might be well to spell out the logic of the process theory-process instruction-learning performance relation.

A general process theory ought to serve as the basis for generating hypotheses concerning the specificity of process deficits and the general form which remediation might take. Process diagnostics ought then to provide the means for selecting a sub-sample of LD children who might reasonably be identified as deficient in the underlying process. Finally, if successful in

remediating the deficit, process-oriented instruction ought to serve both the practical function for which it was designed and the more properly scientific function of validating the process model from which it was derived. This validation should, theoretically, occur at two levels. On the first level, the success of process-oriented instruction should be reflected in process-oriented measures. If, for example, ability to scan systematically has been identified as the target process, then post-instructional measures of the systematicity of visual scanning ought to reflect that improvement; and they should reflect it in a generalized fashion. Increased systematicity of visual scanning, in other words, should be broadly manifest in a variety of scanning tasks.

Validation, however, can also occur at a second level. If the process-specifying theory is, as it ought to be, a more general theory of learning, then remediation of a process deficit should, under conditions to be discussed, be reflected in the overall learning capacity which that process is assumed to underlie. With respect to the previous example, instruction in systematicity of visual scanning might, under certain conditions, be expected to show up in a facilitation of reading acquisition. But what are these conditions? Unfortunately, they are very rarified. In order for instruction in an underlying process such as systematic scanning, even when it is successful, to be reflected in acquisition of some specific task performance, it is logically necessary that the child have a deficit in just this one process (or at least in no other process necessary for task acquisition) and that the instruction in task specifics be completely adequate. In other words, if a child has a variety of process

deficits and process training singles out only a single deficit as the target for instruction or, even if the child has a single deficit but the task-specific information necessary for task acquisition is inadequately presented, training in the single target process can not be expected to effect an improvement in the broader learning task. To provide an extreme example, no amount of training in the systematicity of scanning will result in improved reading acquisition in a child who has a severe problem with auditory analysis precluding the establishment of spelling pattern-sound pattern correspondences nor will training in the systematicity of scanning facilitate reading acquisition in a child whose reading instruction is inadequate. This should begin to make clear why the failure of process-oriented instruction to produce a measurable impact on specific classroom tasks can not be unambiguously interpreted as reason to reject the process theory.

With this discussion as background, we are now in a position to specify four different but complimentary explanations for the failure of process training to have a measurable impact on the acquisition of academic skills (i.e., on learning broadly construed). Three of these explanations have already been alluded to and will, therefore, only be briefly summarized. The fourth explanation, which has not been previously discussed, will be dealt with in more detail, particularly as it relates to comparable issues in the Soviet literature.

First, as already noted, adequate process instruction requires both adequate process theory and adequate theoretically-specified diagnostics. Given the lack of a well-supported, integrated, cognitive account of learning

and the mismatch between available psychometric product measures and the need in process instruction to assess process, it seems hardly any wonder that available process training programs are themselves less than all that might be desired.

Second, as also noted, the absence of adequate process diagnostics has led to the experimental treatment of LD children as though they constituted a homogeneous group. On the available evidence, there is good reason to suppose that such treatment lumps together children who may be characterized by widely varying process deficits. Consequently, in process instruction, some children may profit greatly; others, either because they do not show a deficit in the process being trained or because they have serious deficits in other processes which preclude successful instruction on the process trained, may find process instruction of little benefit. Since evaluation of program impact is typically geared to group performance, the added error variance contributed by program-irrelevant, within-group variability of the subject population substantially reduces the liklihood that positive effects will be detected even if they are achieved for the appropriate sub-sample.

Third, as just discussed, process training is training in task-general competencies, i.e., in processes assumed to underlie task performance. Consequently, although process competence may generally be assumed to be a necessary condition for adequate task performance, it is not sufficient. Rather, the sufficient conditions for performance include all of the various process competencies which are task relevant, knowledge that these processes are task relevant, and all essential task-specific information as well. Ability to scan systematically, for example, is a task general competence

which might be presumed to be necessary for reading performance. It is quite obvious, however, that it is far from sufficient for such performance. In addition to ability to scan systematically, reading performance requires a great deal of reading-specific knowledge not the least of which is the knowledge that reading is a task for which systematic scanning is appropriate and that English is a language whose orthography proceeds from left to right and top to bottom. Successful performance requires both process competence and task-specific knowledge. The implication of this is that, although process analysis and task analysis are often viewed as opposed approaches to instructional design, they are in fact better construed as complimentary. Theoretical process analysis and process-oriented instruction must be supplemented by task analysis and task-oriented instruction if competence is to be translated into performance.

Fourth, instruction in task-general processes must be simultaneously task-general and task-relevant. There is a tendency in all children, possibly even enhanced in LDs, to overassociate process-training with the specific task performances through which the process is trained. Children do not easily come to the realization, in other words, that processes under instruction have a degree of task generality, that they can be extracted from the instructional situation and transferred to a variety of other tasks. Concomitant with this tendency in children to bond the trained process to the training situation is an insensitivity to cues specifying the applicability of a task-general approach to a newly encountered situation. To employ the scanning example once again, training in systematicity of visual scan must lead the

child to an awareness both that a systematic visual approach is valuable in a variety of performance areas other than those employed in training and that there are cues to look for in newly encountered situations which signal the applicability of a systematic visual approach to the task at hand. Designing process-oriented instructional programs so as to induce task-generality in process application while at the same time providing the child with means to recognize tasks to which the process is applicable is no easy matter. Yet if these requirements are not adequately taken into account in instructional design, there is no reason to expect (even when theories and diagnostics are adequate, subject-selection is refined and process appropriate and task information is provided) that process-oriented instruction will facilitate "learning" broadly construed.

Although this issue is not discussed in precisely these terms in the Soviet literature, there are elements of both the general Soviet psycho-philosophical orientation and Soviet psycho-educational practice which may be interpreted as bearing rather directly on the problem. The relevant psycho-philosophical principle is that of "self-development" and the element of practice is that of designing instruction so as to foster a conscious, strategic approach to task performance. Specifically, for Soviet educators, the principle of "self-development" implies that the essential task of education is to provide children with internalized, consciously understood principles for the organization of their action (i.e., strategies). By means of fostering a conscious strategic approach to task performance, the source of the control of action can be gradually shifted from the teaching adult to

the child. The child thereby becomes increasingly capable of self-development through voluntary action.

Since the primary instrument of conscious awareness and the control of voluntary action is thought by Soviet psychologists to be language (Luria, 1961), the direct implication of this view is that strategic instruction should occur within a verbal self-instructional framework. This implication accords well with a trend toward self-instruction already becoming apparent in the American literature (Meichenbaum, 1977). It is not difficult to understand why. The verbal self-instructional format would seem to afford a number of potential advantages. First, by its nature, language abstracts and generalizes. Consequently, the use of verbal self-instruction in process training might be expected to facilitate the child's extracting the task-general aspects of process strategies from the training situation to which they might otherwise remain bound. Secondly, verbal self-instruction provides the child with a representational form through which strategies may be more easily transferred to newly encountered situations. Thirdly, through verbal self-instruction, children might themselves learn to employ a variety of task analytic procedures (i.e., through questions which they ask themselves about new tasks) to enhance the liklihood that cues as to the task appropriateness of a given process will be detected. Finally, and of particular importance with LDs, verbal self-instruction can substitute for direct and immediate action in a situation, thereby effectively inhibiting the immediate, impulsive response which can interfere with adequate pre-performance intake of task information.

Conclusion. In concluding, it might be well to summarize the various suggestions for future American research and practice which have been discussed in the previous sections with reference to the Soviet literature. In general, it might be suggested that American research would do well to focus on: 1) constructing an adequate general theory of the integrated system of psychological processes underlying knowledge acquisition; 2) developing adequate, theoretically-justified, process diagnostics in order to foster a more refined treatment of learning disabilities in place of the current relatively undifferentiated view of learning disability; 3) adapting the multi-stage "zone of potential development"-type format for providing graded organizational assistance to the task of constructing adequate process diagnostics; 4) integrating the design of process-instruction into programs of research geared to developing process theories not only as a means to improving process instruction but also as a means to validating process theory; 5) coordinating process analysis (across tasks) with task analysis in the design of instructional programs which can offer training in both task-general processes and the task-specific knowledge necessary to classroom performance; and 6) exploring the potential of verbal self-instruction to facilitate the generalization and transfer of basic process instruction from the training situation to newly encountered tasks for which the processes under instruction are appropriate.

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